Synthesis & Investigation of the Mechanical behaviour of Luffa, Groundnut Shell, Chicken Feather and Cowdung Fibers Reinforced Epoxy Composites

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Abstract— The invention and subsequent growth of composite materials has bought a revolution in the world over the last three decades. The composite materials were available in the olden days in many forms are under a tremendous research now a days because of its high strength to weight ratio especially in structural applications. The main theme of composite material is to reduce the weight and improve mechanical properties .To obtain this we prepared a new composite material that consists of ground nut coir fiber powder and, chicken feather powder, luffa powder, cow dung powder .we named it as GCLC COMPOSITE MATERIAL. The mechanical behaviour and the properties are explained by using experimental results. In India, large number of ground nut plants available at Gujarat (27.87%) and Andhra Pradesh states (24.19). and luffa plants are highly available in U.P and Punjab. So large number of ground nut coir and luffa is available for preparation of composite material. And also large amount of cow dung are available from neighbourhood sources and chicken feather are also available treated& un treated conditions .cow dung and chicken feather both are waste by products for making of composites.

Key words: Luffa powder, Cow Dung Powder, GCLC Composite Material, Chicken Feather

I. Introduction

A. *Composite Materials*

Generally Composite material consists of physically and chemically distinct materials which have their own properties. On combining the new material shows a unique property. It shows better mechanical properties than that of other metals. Generally composites are less weight so it reduces the overall weight of the components.

So to obtain for these properties we prepared a new composition composite material by combining chicken feather, groundnut shell powder, cow dung powder and luffa powder we named it as CGCL COMPOSITE MATERIAL. We had investigated the different mechanical properties and are represented.

B. *Definition*

Albeit composite materials had been known in different structures all through the historical backdrop of Mankind, the historical backdrop of modern composites probably began in 1937, when an engineer became in trigged by a fiber that was formed during the process of applying lettering to a glass milk bottle.

The initial products for this finely drawn fiber glass we reacts as insulation (glass wool) but structural products soon followed. These materials helpful in creating new aircraft designs and innovative concepts in manufacturing, as most of these innovations require new materials.

A composite material is May joining at least two disparate materials. They are consolidated in such a way that the resulting composite material or composite possesses superior properties .which are not realistic with a solitary constituent material In this way, in specialized terms, we can characterize a composite as 'a multiphase material from a mix of materials, varying in sythesis or shape, which remain fortified together, however hold their personalities and properties, without going into any substance responses.' The parts don't break down or totally combine. They keep up an interface between each other and include show to give enhanced, particular or synergistic qualities not realistic by any of the first segments acting separately. Bone is a straightforward case of a characteristic composite material having the best properties of its constituents. A bone is comprised of two essential sorts of materials- - natural and inorganic. The natural part, comprising for the most part of proteins, sugars and fats, makes it malleable and gives the required delicate quality. The inorganic part, comprised of calcium phosphate, gives it the required quality and unbending nature.

The most common synthetic composite material is glass fibre reinforced plastics (GRP) which is made out of plastics and glass fibre. The individual parts have by and large extraordinary properties to that of the composite material, GRP.

Plastics are light, durable, have excellent corrosion resistance and can be easily moulded to any complex shape. But they are not fit for load-bearing applications because of lack of sufficient strength, stiffness and dimensional stability. Glass fibre, on the other hand, possesses very high strength and is sufficiently stiff and durable. Like plastics, it also cannot be used for load- bearing applications because of its brittleness and fibrous structure. But when both of these are combined in the correct Proportions and a particular glass fibre arrangement, we obtain GRP which has the improved mechanical and other properties suitable for load- bearing applications.

II. Manufacturing methods

These composite materials can be manufactured by different methods. They are as follows

- Manual Lay-Up Method:
- Automated Lay-Up Method
- Spray-Up Method
- Filament Winding Method
- Pultrusion Method
- Advanced Composite Materials

A. Manual Lay-Up Method

Manual lay-up involves cutting the reinforcement material to size using a variety of hand and power-operated devices. These cut pieces are then impregnated with wet network material, and laid over a shape surface that has been covered with a discharge operator and after that ordinarily a sap gel-coat. The impregnated fortification material is then hand-moved to guarantee uniform circulation and to expel caught air. Greater fortification material is included until the required part thickness has been developed. Manual lay-up can likewise be performed utilizing pre-impregnated support material, called 'prepare'. The utilization of prepare material disposes of independent treatment of the support and tar, and can enhance part quality by giving more predictable control of fortification and sap substance. Prepare must be kept refrigerated preceding use, be that as it may, to avert untimely curing.

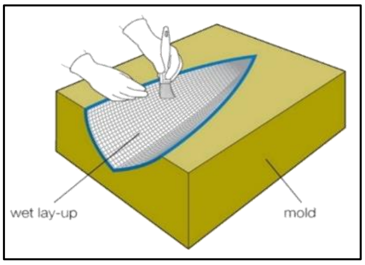

Fig. 1: Manual Lay-Up Technique Process Top view

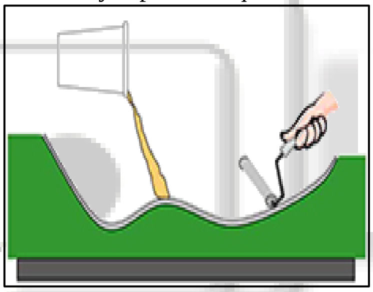

Fig. 2: Manual Lay-Up Technique Process Side view

B. Pultrusion Method

Pultrusion is a continuous process used primarily to produce long, straight shapes of constant cross-section. Pultrusion is similar to extrusion except that the composite material is pulled, rather than pushed, through a die. Pultrusion are produced using continuous reinforcing fiber called 'roving' that provide longitudinal reinforcement, and transverse reinforcement in the form of mat or cloth materials. These reinforcements are resin impregnated by drawing through a resin wet-out station; and generally shaped within a guiding, or performing, system. They are then subsequently shaped and cured through a preheated die or set of dies. Once cured, the pultrusion is saw-cut to length. Pultrusion can be hollow or solid, and applications include bar and rod, pipe, tubing, ladder rails and rungs, and supports of many kinds.

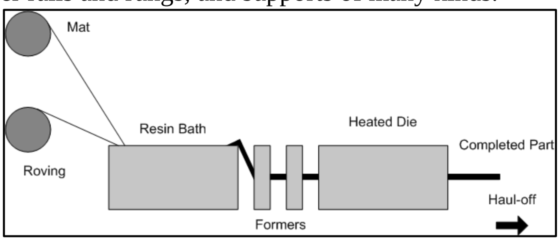

Fig. 3: Pultrusion Method

III. PREPARATION OF MATERIALS IN POWDER FORM

A. Preparation of Luffa Powder

We collected large amount luffa aegyptiaca nearly 30kgs from a local Seller. These collect edluffa aegyptiaca contained inner and outer layers. In This research work we need only fibre i.e., luffa aegyptiaca is cut into two half's and removes rough inner portion of contained of luffa. Then take out only fibre contained portion. The fibre is cut it in to Small Small pieces and then washed with water and NaOH solution to remove the Contaminants and adhering dirt. Then after are exposed to sunlight for72 hrs for drying process. After drying these luffa fibre are ready for the preparation of Luffa aegyptiaca fibre powder.

Fig. 4: Raw Luffa aegyptiaca Cleaned & dried luffa fibre

Fig. 5: Preparation of luffa powder by size using hand lay-up method & powder for uniform grain size

B. Preparation of Ground Shell Fiber Powder

Groundnut otherwise known as *Arachishypogeae*is regarded as one of the most important protein-rich and it occupies the fifth position as oilseed crop globally.

Groundnut shell is a waste item acquired after the expulsion of groundnut seed from its case, and there has not been extensive interest for the use of groundnut shell for the benefit of mankind. Groundnut shell is a natural fibre and used as waste by product that can be used as reinforcing filler in polymer composite.

By taking the ground shell husk, which is chemically treated with water and NAOH solution. Then dry it in presence of sunlight nearly by 48 hrs. In ,this research work we are taking nearly 5kg of ground nut shell husk for the preparation of ground nut shell powder.

Fig. 6: Groundnut shell husk

C. Preparation of Cow Dung Powder

Cow dung obtained from neighbourhood sources and some of these fibres were soaked in 5% NaOH solution for 30 min. To remove any slippery material and hemicelluloses, cleaned thoroughly in purified water and dried up in the presence of sunlight for 72 hrs.

Fig. 7: Cow dung was dried after 48 hours in treated condition

Fig. 8: Seaving of cow dung powder for uniform grain size

The above figures show that ,after drying the cow dung and then powdered it by using hand lay-up method then after seaving it for uniform grain size. In this research work we are using only uniform grain size powder.

D. Preparation of chicken feather

The CFF are generally depicted as a waste by-item and they are adding to ecological contamination because of the transfer issues. There are two fundamental diverse chicken quill transfer strategies are exist, they are consuming and covering. The two have negative effect on nature. Late reviews on the chicken plume squander exhibited that the waste can be a potential composite fortification. The composite support use of the CFF offers considerably more successful way to solve ecological concerns contrasted with the customary transfer strategies. A portion of the benefits of the CFF are in-costly, sustainable accessible. The CFF as a composite fortification having certain alluring properties including lightweight, high warm protection, fantastic acoustic properties, nonabrasive conduct and magnificent hydrophobic properties. The CFF has the most reduced thickness esteem contrasted with the all regular and engineered filaments. The found that the CFF keratin biofibers permits an even dissemination inside and adherence to polymers due to their hydro-phobic nature and they revealed that CFF fortified composites have great warm strength and low vitality scattering.

Chicken quills are constantly viewed as a waste by item from the preparing of chickens for nourishment. Chicken plume fiber (CFF) offers a vast, shoddy fiber advertises as an added substance for medium thickness fiber board (MDF). Chicken plumes comprise of around half fiber and half plume (by weight). Both the fiber and plume comprise of hydrophobic keratin, a protein with quality like that of nylon and with a distance across littler than that of wood fiber. The fiber is more strong than the plume and has a higher perspective proportion. Finding a high-volume, high esteem use for CFF, which is most generally land filled or utilized for bolster protein, would incredibly profit the poultry business and would speak to another wellspring of fiber for the wood business.

In this research work ,we collect the chicken fiber soaked with water then dried it in the presence of sunlight with 48 hrs, then after seaving it for uniform grain size by using Hand lay-up method.

Fig. 9: Preparation of chicken feather by using hand lay-up method

Fig. 10: chicken feather with uniform grain size

IV. METHOD OF MANUFACTURING SPECIMEN

A. Experimental Methods

For the preparation of composites the ground nut shell powder , chicken feather , luffa powder and cow dung powder are mixed in the proportion of different ratios for 4 different specimens are 46:4:30:20, 37:6:27:30, 27:8:25:40, 17:10:23:50. Initially epoxy Resin and Hardener were mixed together based on the weight ratio to form a matrix.

Fig. 11: Epoxy resin (LY556) &Hardener (951)

Materials used in this experimental work are Epoxy resin, Hardener, ground nutshell powder, Cow dungpowder, chicken feather fibre, luffa powder. Epoxy resin (Araldite) is a thermosetting epoxy resin of medium viscosity supplied by Sree industrial composites products Pvt. Limited, miyapur, Hyderabad, India having outstanding properties as the matrix material like excellent adhesion to different materials, high resistance to chemical and atmospheric attack, high dimensional stability, excellent mechanical properties, nontoxicnature and negligible shrinkage. Hardener HY-951 is used to harden matrix material.

The cleaned ground nut shell, cowdung were crushed into small pieces by using hammer. These small pieces then converted into powder by using hammering and machining process. The collected powder was then sieved to different mesh sizes.

B. Sample Preparation

For the preparation of the composite we calculate the percentage of fibres, are required from the table we come to know about the amounts accurately. Percentages are taken based up on literature surveys only.

Specimen	% wt of Groundnut shell	% wt of Chicken feather	% wt of Luffa powder	% wt of Cow dung powder	Total % of wt
A	46	4	30	20	100
B	37	6	27	30	100
C	27	8	25	40	100
D	17	10	23	50	100

Table 1: Sample preparation

Fig. 12: Tensile Test Specimen

Fig. 13: final components

V. TESTING OF THE SPECIMENS

A. *Conducting of the tensile test of specimen*

This test reveals the amount of energy absorbed by a material during fracture, which refers to the materials tensile strength. The tensile strength test for specimens of dimension 300 mm length and diameter of 25 mm was obtained by using Universal testing instrument is used in this test. The impact strength is calculated from the following relation

Tensile stress = Tensile force / area = N/ mm^2

B. *Conducting of the compression test of specimen*

This test uncovers the measure of vitality consumed by a material amid break, which alludes to the materials pressure quality. The pressure quality test for examples of measurement 25mmX 300mm was gotten by utilizing Circular tube all inclusive testing machine instruments is utilized as a part of this test. The pressure quality is ascertained from the accompanying connection.

Compression stress = compression force / area.

C. *Conducting of the impact test of specimen*

Impact is a single point test that measures a materials resistance to impact from a swinging pendulum. Impact is defined as the kinetic energy needed to initiate fracture and continue the fracture until the specimen is broken. The impact tests are carried out as per ASTM standards using an impact tester. Four samples were tested at ambient conditions and the average of impact strength was calculated.

D. *Conducting of hardness test of specimens*

Hardness is the resistance of a material to plastic deformation usually by Indentation. The term also refers that to the resistance to penetration, indentation, scratching, abrasion, or cutting. Indentation hardness is a number related to the area or to the depth of the impression made by an indenter of geometry under a known static load.

Select proper indenter which is having the die of 25mm based up on the ASTM standards. And apply proper loads on each specimen having 60kgs, 100 kgs, and 150 kgs. For reach specimen apply above loads at various places and each place calculate the dia of the impression by using verneircalipers. Finally calculate mean values of the loads and dia of indentation for each specimen. Here using theRAB-250 Hardness Tester.

VI. CALCULATIONS

A. *Calculation for tensile stress*

specimen compositions chicken feather, groundnut shell powder, cow dung powder, luffa powder ratios	Peak Load (KN)	Elongation (mm)
A (4:46:20:30)	6	6
B (6:37:30:27)	8	12
C (8:27:40:25)	10	18
D (10:17:50:23)	11	21

Table 2: Calculation for tensile stress

1) *Specimen A in the ratio of 4:46:20:30*

- Cross sectional area of the specimen $(A) = \pi r^2$ = 491.0714mm^2
- Tensile stress = Tensile force / area = 6000/491.0714 =12.2231 MPa
- Strain due to tensile force = change in length / original length =0.02mm
- % of elongation = change in length / original length *100 = 306-300/300 = 2%
- Young's modulus = stress/ strain = 12.2231/0.02 =611.155MPa

B. *Calculation for compression stress*

specimen compositions chicken feather, groundnut shell powder, cow dung powder, luffa powder ratios	Compression force (KN)
A (4:46:20:30)	9
B (6:37:30:27)	11
C (8:27:40:25)	13
D (10:17:50:23)	15

Table 3: Calculation for tensile stress

1) *Specimen 'A' In the Ratio Of4:46:20:30*

- Cross sectional area of the specimen $(A) = \pi r^2$ = 491.0714286 mm^2
- Compression force of the specimen = 9KN
- Compression stress = compression force / area
- Compression stress of the specimen=(9000/491.0714286) = 18.3346 MPa

C. *Calculations for Hardness Test*

Specimen	Load(f)&dia(d) Trail- 1	Load(f)&dia(d) Trail- 2	Load(f)&dia(d) Trail- 3	Mean
A	60 & 1.6	100 &2.2	150 & 1.7	103.33 &1.83
B	60 & 1.3	100 &2.1	150 & 1.4	103.33 &1.6
C	60 & 1.4	100 &1.5	150 & 1.8	103.33 &1.56
D	60 & 1.3	100 &1.6	150 & 1.7	103.33 &1.53

Table 4: Calculation for tensile stress

1) *Specimen 'A' In the Ratio of 4:46:20:30*

– Brinell Hardness Number (BHN) = 2F/πD (D-√D2 – d2) = 2* 103.33*9.81 /3.14*2.5(2.5-√(2.5)2 –(1.83) 2) = 323.98

VII. RESULTS AND DISCUSSIONS

Specimen Ratios	Tensile Strength (N/Mm^2)	Compression Strength (N/Mm^2)	Hardness Strength	Impact Strength (Joules)
A(4:46:20:30)	12.2231	18.3346	323.98	2
B(6:37:30:27)	16.2974	22.4091	445.769	4
C(8:27:40:25)	20.37183	26.48338	465.23	6
D(10:17:50:23)	22.40901	30.55777	493.786	9

Table 5: Results and Discussions

VIII. CONCLUSION

The mechanical behaviour of the CGCL composite material has been estimated in the present work. The materials of CGCL composite had taken in different ratios are mixed with resin and hardener and made into geometrical shapes. These have been tested experimentally for Tensile, compression, hardness and impact tests. The results found as high tensile test for CD composition, because Of luffa powder(23%)alwayshave good tensile strength and strain and decreasing the Groundnut shell powder percentage (17%) because it act as the filler material as compare to the other compositions like A,B and C to get higher values from 12.2231MPa to 22.40901MPa. for compression test CD composition has good compression strength, because of chichen feather fiber(10%) and treated cow dung powder (50%)have good compressive properties and while increasing the percentages of chicken feather and cowdung powder automatically the compressive strength increases and get the high values increased from 18.3346MPa to 30.55777MPa. For hardness and impact tests CD composite material contains high hardness values increased from 323.98 to 493.786 and impact strength values increased from 2KJ to 9KJ. So from this experiment we conclude that the tensile strength of composite depends on luffa powder and groundnut shell powder and compression strength of composite depend on cowdung powder and chicken feather. Hardness and Impact strength of composite allways depend up on the cowdung, chicken feather and luffa powder and groundnut shell powder used as filler material.

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